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Assessment of Computational Methods for Simulating AC Plasma Display Panels*

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This paper compares fluid and particle simulations for configurations typical of double-substrate AC plasma display panels. The purpose is to test the validity of various approximations used in fluid simulation codes. For fluid simulations, assumptions are usually made regarding the dependence of the electron transport and rate coefficients on, for example, the local and instantaneous value of the electric field. The use of the local field approximation is tested by comparing with a fully-kinetic code based on a particle-in-cell/Monte-Carlo-collision simulation. We observe that the local field approximation fails to describe the electron and ion kinetics in the presence of large field non-uniformities in the cathode fall region. This leads to large discrepancies in the voltage transfer curve and the sustaining voltage margin. The comparison to the particle simulations is significantly improved by adding the energy and momentum relaxation equations in the fluid description of the electron and ion kinetics, respectively.
The level of sophistication used to describe the dynamics of the discharge in plasma display panels will determine how computationally intensive and how practical the model is. This is a critical issue especially when the discharge dynamics is coupled with a comprehensive set of plasma chemistry that describes the numerous production and loss processes which control the populations of the radiating states. This work has enabled us to establish the minimum set of moment equations required in a fluid simulation code to accurately describe the evolution of the field and charged particle distributions in plasma display panels.

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